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ABSTRACT

In an effort to improve communication and interaction between students and instructors, improve the presentation of course material, and assess the cognitive development of students, a Quasi-Mastery Learning System (QMLS) of instruction was developed for a community college course in General Chemistry (GC). The QMLS incorporates eight features: conceptual organizers presented before topics, direct and indirect class interaction, a non-threatening class environment, incorporation of educational goals into lectures, prescriptive remediation, formative evaluations for feedback, summative evaluations to measure progress, and class demonstrations. To assess the effectiveness of the system, characteristics and outcomes for 116 students enrolled the QMLS GC course were compared to those of 111 students enrolled in a GC course utilizing a traditional lecture format. In addition, an affective evaluation survey was administered to the QMLS students, of whom 88 returned usable responses. Results of the assessment included the following: (1) analysis of the overall lecture grades of QMLS students showed that their performance was significantly better than that of the traditional students; (2) 13.8% of QMLS students withdrew, compared to 20.7% of the traditional students; and (3) 89.8% of respondents to the affective evaluation felt the educational objectives of the QMLS class were clearly defined, 86.4% thought that the class environment was conducive to learning, and 77.3% felt that higher grades were achieved because of QMLS. Data tables and graphs are appended. (MAB)

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THE QUASI-MASTERY LEARNING INSTRUCTIONAL SYSTEM FOR COMMUNITY COLLEGE CHEMISTRY

Presented at the
NISOD'S 14th Annual International Conference
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May 24 - 27, 1992

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The purpose of the study was to design a comprehensive system of quality instruction for community college chemistry, called the Quasi-Mastery Learning system. The system is an adaptation of Benjamin Bloom's Mastery Learning (1968), possessing four of the five major elements of the Mastery Learning: (1) learning objectives; (2) previously set standards for mastery; (3) formative tests; and (4) additional learning experiences (Dunkleberger & Heikkinen, 1983). However, in the Quasi-Mastery Learning method, there is a time limitation of a semester (approximately 15 weeks) to complete the course.

Students enrolled in General Chemistry with Qualitative Analysis I at the selected community college are mostly freshmen. High attrition rate has been observed for the past five years of more than 20% (average), at the selected community college, in the first semester of General Chemistry with Qualitative Analysis I (CHM 1045C). The experimenter was aware of the difficulty students encountered in this field and opted to design a comprehensive method to improve communications and interactions

between student and instructor, to provide a meaningful and organized presentation of the material, and to assess the cognitive development of the student, while alleviating the problem of low retention in this chemistry course.

The study addressed six basic questions:

1. What effect did the Quasi-Mastery Learning System have on student achievement?
2. Did the students' perceptions toward the Chemistry change with the Quasi-Mastery Learning System?
3. How did the students evaluate the Quasi-Mastery Learning System?
4. Did the Quasi-Mastery Learning System have an effect on student retention?
5. Was there a correlation between student achievement in the lecture portion of the course to student achievement in the laboratory portion of the course?
6. What were the advantages and disadvantages of the Quasi-Mastery Learning System compared to the traditional system?

Research Design

The treatment received by the control group (111 community college students enrolled in General Chemistry with Qualitative Analysis I, CHM 1045C) was a traditional lecture approach to the instruction of chemistry. The treatment received by the

experimental groups (116 community college students enrolled in General Chemistry with Qualitative Analysis I, CHM 1045C) was the Quasi-Mastery Learning system of instruction.

The Quasi-Mastery Learning System of Instruction incorporates the following features:

1. Advanced Organizers
2. Class Interaction/Direct and/or Indirect Influence
3. Qualitative Tone of Lecture
4. Educational Objectives
5. Prescriptive Remediation
6. Formative Evaluations
7. Summative Evaluations
8. Class Demonstrations.

1. Organizers. Every new topic was introduced to students using an Expository Organizer to help students anchor new ideas to familiar ideas and concepts. A Comparative Organizer was used to integrate new concepts with basically similar concepts in cognitive structure, as well as to increase differentiation between new and existing ideas. This type of organizer was used at the beginning of lecture, whenever the lecture was a continuation of a topic. As a natural part of the planning stage of lectures, a conceptual flow chart (map) was prepared by the instructor. The map was used as a guideline to follow in the presentation of the advance organizers; it was not

presented to the students.

2. Direct and/or Indirect Influence. Direct influence was utilized when facts were presented about the content area or when asking rhetorical questions. Indirect influence was utilized when the instructor asked questions to students about content or procedure. Mostly, the lecture presentation was a combination of the direct and indirect influence.

3. Qualitative Tone of Lecture. The tone of lecture and the non-verbal communication were taken into consideration to create a friendly climate in the classroom; it was non-threatening and encouraging to the students when clarifying ideas or suggestions. From the very first day, students were encouraged to ask questions. To engage students further in a topic, several textbooks were available on reserve at the Learning Resource Center (Library). Students were given instruction on how to study chemistry and how to take exams. Test anxiety was relieved by giving students the opportunity to take the Summative Evaluations at the Test Center of the School, within 24 hours of the assigned date of the exam. Although students were regarded as responsible for their learning, the instructor adopted an explicitly active role to ensure that such learning took place. Students were encouraged to come to the blackboard; the instructor asked leading questions to the students in order to elicit students' reasoning of the solution of the problem. This guided reasoning helped other students in

the class as well. The instructor continued intervening in the learning process whenever it was considered opportune. In some instances, whenever students appeared insecure, they were directed to read their class notes and even the textbook before answering a given question. The instructor communicated to the students with confidence that the majority of them had the potential to master each unit of the course to a high level, provided they dedicate enough time and perseverance in their studies. The establishment of a learning environment that promoted the students' self-esteem was one of the important goals of the instructional system.

4. Educational Objectives. Educational objectives were composed for every topic and distributed before the topic was discussed. Statements of instructional objectives specified what the student was expected to accomplish. As the course proceeded, some objectives were adjusted due to differences among the students in the classes. Objectives provided students with an advanced organizer of the topic under discussion and an opportunity to compare their performances with the criteria in the objectives. Formative and summative evaluations were congruent with the educational objectives.

5. Prescriptive Remediation. Learning was also encouraged to take place outside the boundaries of the classroom. The instructor expected and encouraged students to select one of the remediation tools made available to them. Four different

kinds of remediation procedures were available to the students; supposedly, the student selected the remediation procedures best suited to his/her learning style and other responsibilities: (1) Review sessions were organized on a weekly basis or on an as needed basis. These review sessions were conducted by the instructor and were informal in nature, covering deficiencies signaled by the formative Evaluations. (2) Students were also encouraged to take advantage of the Tutoring Center at the school. The center provided students with three and one-half hours per week of free tutoring. A referral from the instructor was necessary to get this type of remediation. (3) A number of computer programs oriented to simulation experiments and computer games were made available to the students. This software was entertaining and challenging in nature and could be used to increase the motivation of the student toward chemistry. (4) A comparison of the Plato Chemistry Software and the course material was distributed at the beginning of the semester. The Plate Software included the first year of general chemistry. All students were trained on how to operate the computers and software.

6. Formative Evaluations. The Formative evaluations were administered approximately once a week or as needed or requested by the students. Students received immediate feedback, which allowed the instructor to identify problem areas. Formative evaluations were short diagnostic tools designed to pinpoint

deficiencies and corrective measures. Students were given approximately 15 minutes to complete these evaluations.

7. Summative Evaluations. These evaluations occurred at the completion of two topics, which corresponded to approximately two chapters. The last summative evaluation was comprehensive over the whole course. These evaluations were designed according to the educational objectives distributed and determined the extent to which the goals of instruction were met. A total of five summative evaluations were administered during the semester. Questions for the summative evaluations were taken from the Test Bank questions accompanying Ebbing's General Chemistry Text. This textbook was used during this project. Students were allowed 50 minutes to complete summative evaluations. These evaluations were announced a week ahead of time and were taken during class time or at the Test Center within 24 hours of the assigned date. For a student to take a summative evaluation at the testing center, he/she had to notify the instructor beforehand and needed a photo-identification to get into the center.

8. Class Demonstrations. Class demonstrations were given every week; they illustrated an important principle covered in class. These demonstrations lasted approximately 15 minutes. These demonstrations consisted of short experiments related to the topic under discussion.

Instruments

In order to assert the cognitive development of the students in the control group, examinations were administered every two chapters. The examination questions were taken out of the test bank accompanying the text book in use.

In the Quasi-Mastery Learning system formative evaluations were administered to the student for diagnostic purposes; as often as the instructor and students deemed it necessary. Prescriptive remediation was assigned as a result of the low class performance on a formative evaluation. Evaluations lasted approximately 10 minutes. The questions composing the evaluations were extracted from the test bank accompanying the textbook being used at the time. Summative evaluations were distributed at the end of two related topics. They consisted mainly of multiple choice questions taken from the test bank accompanying the textbook in use at the time.

The affective evaluation instrument of the Quasi-Mastery Learning instructional system was developed by the researcher with the assistance of a psychologist and the research advisor, using as guidelines other affective evaluations found in the literature (Baker & Piburn, 1988; Burger, 1975). This instrument provided the researcher with an assessment of how the students view the Quasi-Mastery Learning system and compared it to other science courses taken previously (Table 16 and Table 18).

Data Collection

Demographic information included sex, age and race. The information was used to compare the two populations (Table 1 & Table 2). All instruments were administered to students during class time.

Retention of students in the Quasi-Mastery Learning System was determined by comparing the percentage of students who successfully completed the Quasi-Mastery Learning System with students who completed the traditional method (Table 4).

Data Analysis and Discussion of Findings

Descriptive statistics were used to analyze data as presented in Table 3. The overall lecture grade for the course reflects that the Quasi-Mastery Learning Group of students performed significantly better ($p = 0.007$) than the traditional students. Results indicated that there was a higher student achievement in the Quasi-Mastery Learning System.

The percentage of students withdrawing from the Quasi-Mastery Learning System amounted to 13.8% and the percentage of students withdrawing from the Traditional System was 20.7% (see Table 4). This demonstrates that the retention of students was higher in the Quasi-Mastery Learning System as compared to the Traditional System. Students evaluations of instructional strategies, remedial tools and classroom climate are summarized in Tables 5 through 7. Figures 1 through 3 relate to the affective perspective of the students toward the Quasi-Mastery

Learning system of instruction.

Summary

This study indicated that the Quasi-Mastery Learning system of instruction was more effective than the traditional method, providing greater student achievement and student retention. The method also provided greater classroom interaction in the form of student participation in class. The friendliness displayed by the students toward the instructor outside of class took the researcher by surprise, but it was a welcomes bonus of the method. The method, though, required an utmost degree of dedication on the part of the instructor.

The success of this project makes the Quasi-Mastery Learning system an interesting instructional alternative to the conventional approach to the instruction at the community college level. The method can be easily adapted to their disciplines and other levels of instruction.

TABLE 1

COMPARISON OF TS* AND QMLS* GROUPS BY AGE, SEX AND RACE

	TS*	QMLS*
Age (years)		
17-21	61.3% (68)	61.2% (71)
22-26	27.9% (31)	25.9% (30)
27-31	5.4% (6)	8.6% (10)
Above 31	5.4% (6)	4.3% (5)
Total	100.0% (111)	100.0% (116)
Sex		
Male	64.9% (72)	62.1% (72)
Female	35.1% (39)	37.9% (44)
Total	100.0% (111)	100.0% (116)
Race		
White (Non-Hispanic Origin)	65.8% (73)	64.7% (75)
Black (Non-Hispanic Origin)	4.5% (5)	5.1% (6)
American Indian or Alaskan Native	1.8% (2)	0.9% (1)
Asian or Pacific Islander	17.1% (19)	16.4% (19)
Hispanic	10.8% (12)	12.9% (15)
Total	100.0% (111)	100.0% (116)

* TS - Traditional System
QMLS - Quasi-Mastery Learning System

TABLE 2

COMPARISON OF THE TS* AND THE QMLS*
GROUPS BY AGE, GPA AND COLLEGE CREDITS

AGE (years)	TS*		QMLS*	
	CREDITS**	GPA**	CREDITS**	GPA**
17-21	30.8	2.9	28.6	3.1
22-26	31.3	3.1	37.5	3.2
27-31	22.0	3.4	41.1	3.2
Above 31	22.6	3.1	26.5	3.2

* TS - Traditional System, N = 92
QMLS - Quasi-Mastery Learning System, N = 107

**Figures reported reflect averages

TABLE 3

OVERALL LECTURE GRADE FOR THE COURSE*

	TRADITIONAL SYSTEM	QUASI-MASTERY LEARNING SYSTEM
Mean	355.9 (80.0%)	378.4 (85.0%)
St. Deviation	48.5	41.1
St. Error	5.2	4.1
Min. Score	168	275
Max. Score	443	440
No. of Students	88	100
No. St. Missing	23	16

t-statistics: unpaired t value = 3.438

p value (two-tail) < 0.007 (n = 186)

Practical Significance = 0.504

* Computed as per syllabus (Appendix C)

TABLE 4

COMPARISON OF STUDENT RETENTION

	NO. OF STUDENTS AT THE BEGINNING	NO. OF STUDENTS FINISHING	PERCENT OF STUDENTS WITHDRAWING
QMLS*	116	100	13.8%
TS*	111	88	20.7%

* TS - Traditional System
QMLS - Quasi Mastery Learning System

TABLE 5

INSTRUCTIONAL STRATEGIES:
QUASI-MASTERY LEARNING SYSTEM OF INSTRUCTION*

	AGREE	DISAGREE	NEUTRAL
The educational objectives were clearly defined.	89.8%	1.1%	9.1%
The test questions were in agreement with the educational objectives.	92.0%	2.3%	5.7%
Having the formative and the summative evaluations graded for the next class helped to learn to learn the information.	86.3%	1.2%	12.5%
The amount of work required was appropriate for the credit received.	92.0%	4.5%	3.5%
Higher grades were achieved as a result of the instruction.	77.3%	2.2%	20.5%
Do you feel prepared to master the next level of chemistry?	69.3%	12.5%	18.2%

* 88 Students responded to the questionnaire.

TABLE 6

EVALUATION OF REMEDIAL TOOLS
USED IN THE QUASI-MASTERY
LEARNING SYSTEM OF INSTRUCTION*

	AGREE	DISAGREE	NEUTRAL
Having the tutoring center available helped the student's success in the course.	36.4%	4.5%	59.1%
Having the corresponding software available helped the student understand the material.	42.0%	9.1%	48.9%
The review sessions were helpful.	81.8%	2.3%	15.9%

* 88 Students responded to the questionnaire.

TABLE 7

EVALUATION OF CLASSROOM
CLIMATE FOR THE QUASI-MASTERY
LEARNING SYSTEM OF INSTRUCTION*

	AGREE	DISAGREE	NEUTRAL
The instruction used in the QMLS relieved the level of anxiety for the course.	71.6%	9.1%	19.3%
I will recommend this chemistry course to others.	76.1%	10.4%	13.6%
I enjoyed the QMLS more than other science courses I have taken.	52.3%	15.9%	31.8%
The course stimulated my thinking.	76.1%	4.6%	19.3%
The QMLS of instruction applied to chemistry changed my apprehension to chemistry in a favorable way.	51.1%	8.0%	40.9%
The material was presented in an interesting fashion.	76.1%	4.6%	19.3%
The environment was conductive to learning.	86.4%	4.5%	9.1%

* 88 Students responded to the questionnaire.

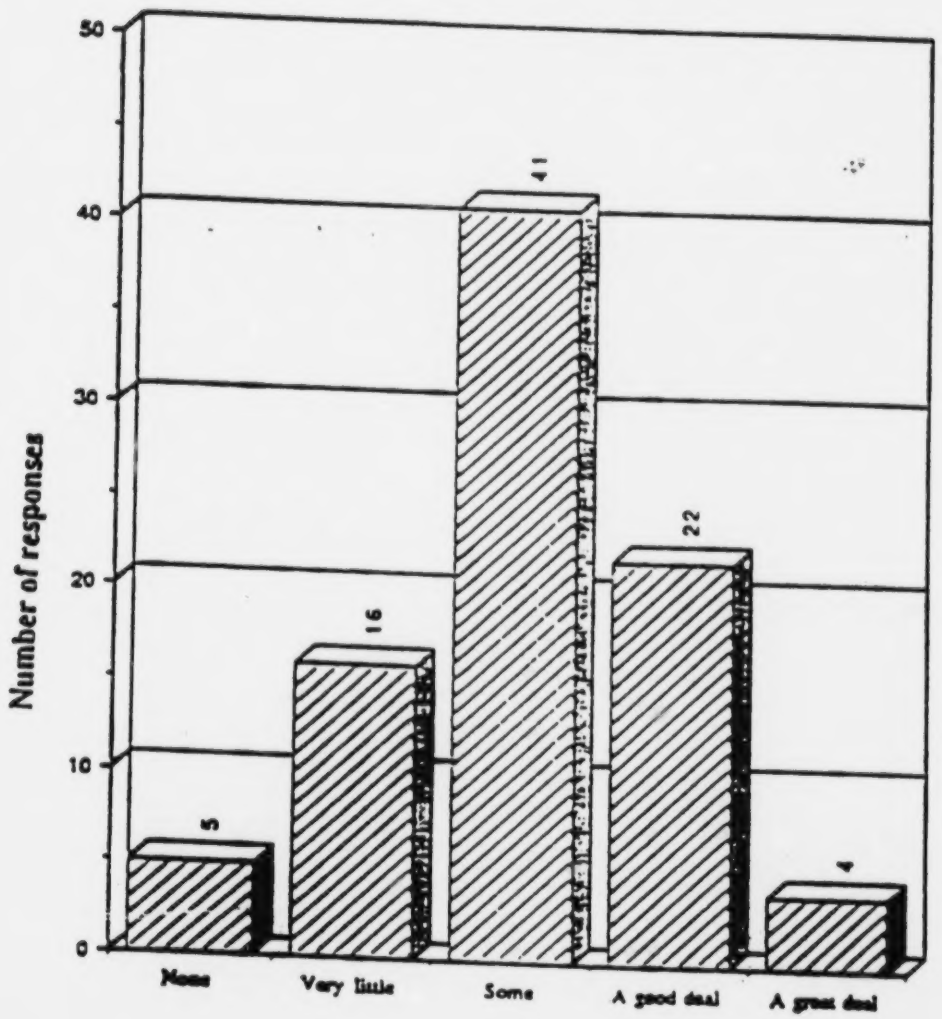

Figure 1 What was your overall level of anxiety during this course?

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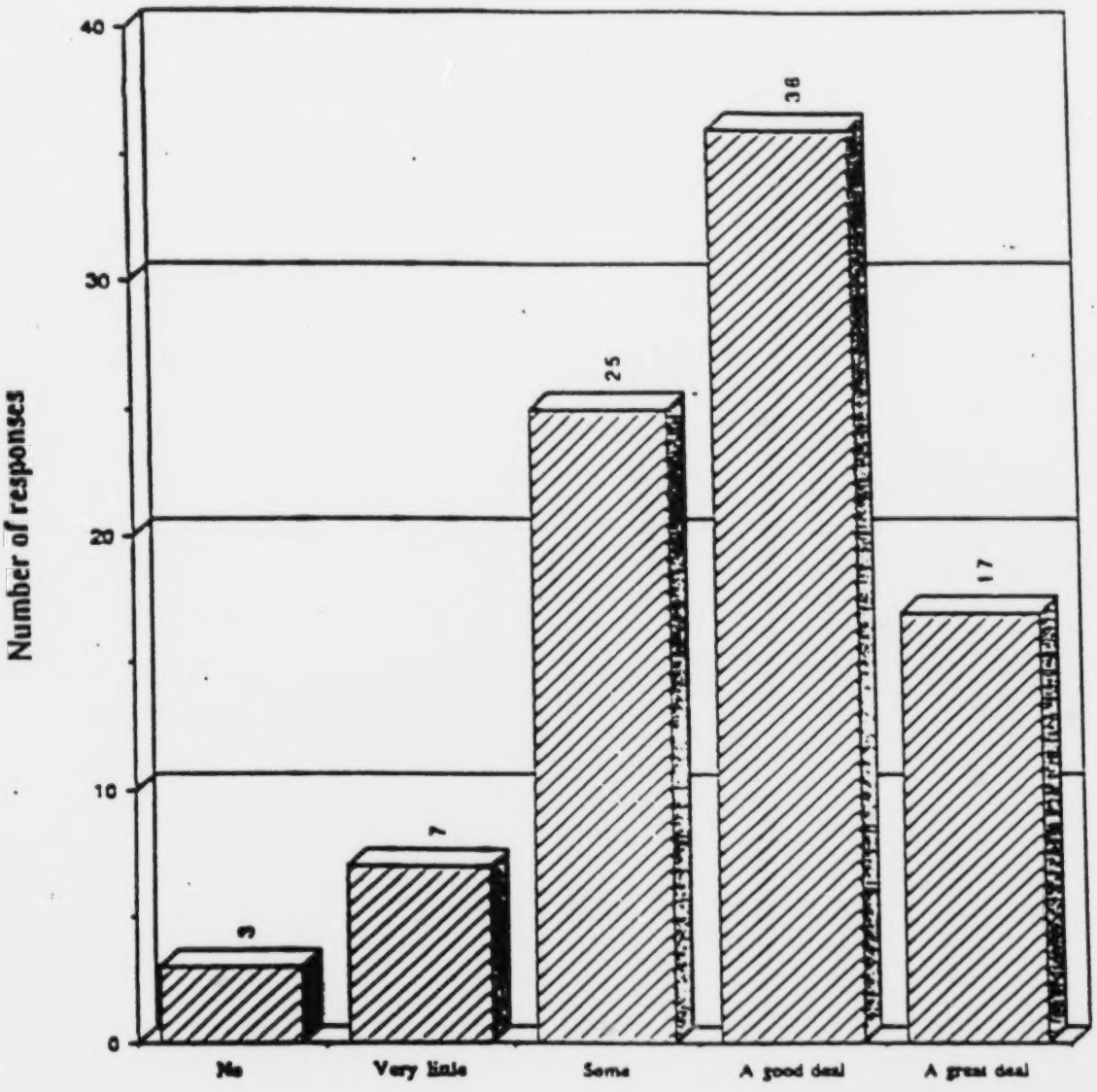

Figure 2 Do you believe the way this course was taught can help you learn chemistry better?

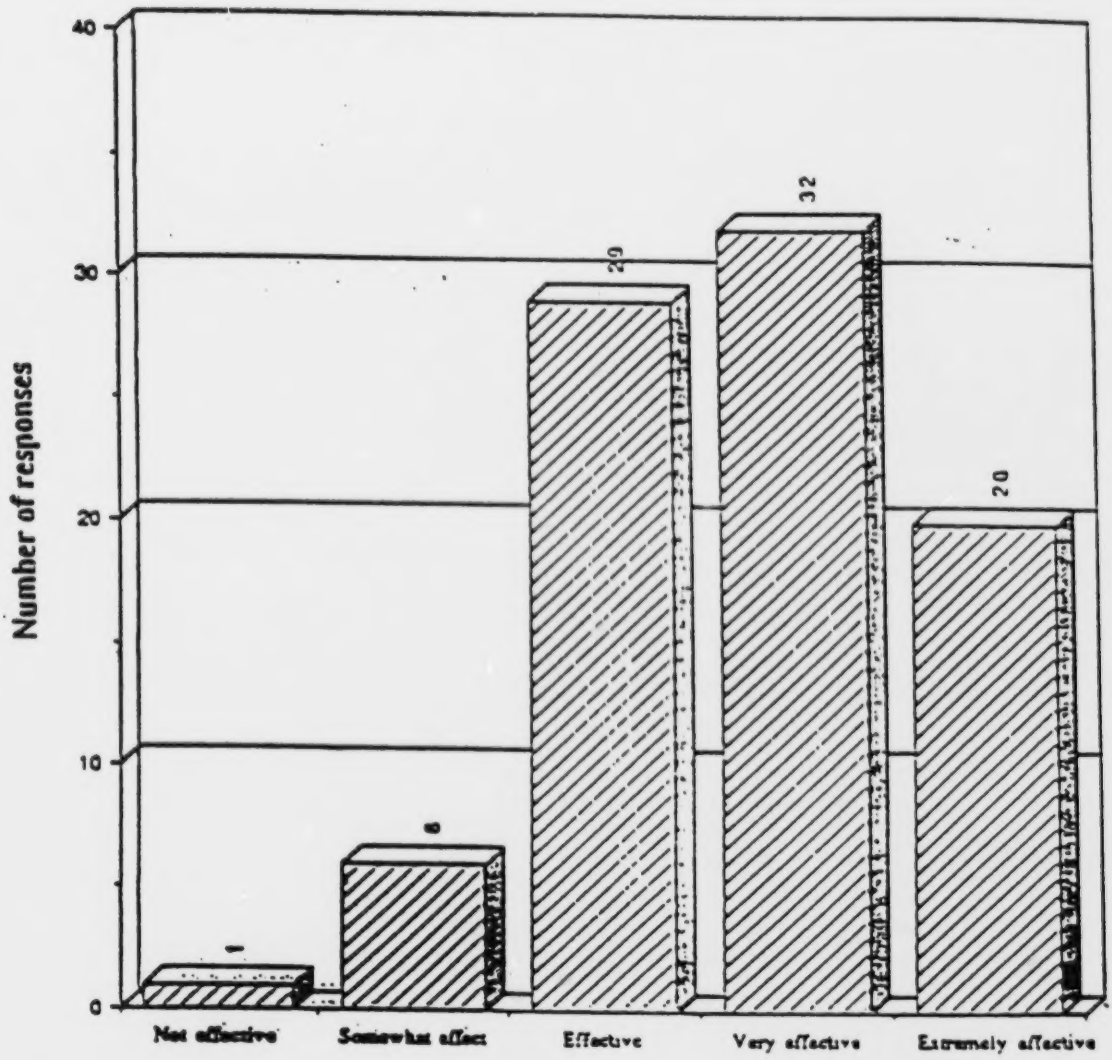

Figure 3 **How would you rate the instructor's teaching methods?**

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